



Search for Life on Other Worlds: What is Life and What Does it Need to Live?

DESCRIPTION

These two activities will lay the conceptual groundwork for understanding questions fundamental to the field of astrobiology. The students will examine the nature of life, what it requires, its limits, and where it might be found as well as learn important ideas related to the search for extraterrestrial life.

OBJECTIVES

Students will

- Compare real and fake or live and dead objects and brainstorm ideas about what life is
- Refine the definition by playing 20 Questions to identify an object or organism
- Test the definition by comparing "mystery" samples
- Grow organisms in 1 of 12 classroom environments and identify common requirements (e.g., water, nutrients, and energy)
- Design a mission to identify habitable places by searching for water, nutrients, and energy

NASA SUMMER OF INNOVATION

GRADE LEVELS

4 – 6

CONNECTION TO CURRICULUM

Science and Mathematics

TEACHER PREPARATION TIME

2 hours

LESSON TIME NEEDED

4 hours

Complexity: Moderate

NATIONAL STANDARDS

National Science Education Standards (NSTA)

Science as Inquiry:

- Understanding of the nature of science
- Skills necessary to become independent inquirers about the natural world

Life Science Standards

- Characteristics of organisms
- Organisms and environments

MANAGEMENT

Students will be working with small containers in order to make their observations. Smaller groups will be an advantage.

Since students will be working with microorganisms, it is very important that they follow sterile procedures washing both before and after the activities. This is particularly important for the “What Does Life Need to Live?” activity which grows molds and pond microbes from the surrounding environment.

Be sure to check the expiration date of the yeast.

CONTENT RESEARCH

Many astrobiologists use the availability of liquid water as the primary criterion for judging whether a planet is a candidate for life. All life requires energy. Organisms use either light energy or chemical energy to run their life processes. Light energy is available only to organisms that live on or close to a planet or moon’s surface.

On planets that are unprotected or too distant from the sun, the only option for organisms is to live beneath the ground and to depend on chemical energy for their needs. Microbes break complex compounds into simpler ones to obtain a small amount of energy from this chemical change. This energy is sufficient to power microbial life.

Once students understand life’s common requirements, they are ready to think about how a planet might provide those essentials. Habitable planets are ones that are able to provide organisms a dependable supply of liquid water, nutrients, and energy. (See pages 11–12.)**

LESSON ACTIVITIES

What is Life?

Compare real and fake—or live and dead—objects and brainstorm ideas about what life is. “Astrobiology in the classroom Life on Earth ...and elsewhere? p. 5

<http://nai.arc.nasa.gov/library/downloads/ERG.pdf>

What does life need to live?

Students will create small environments for microbes to thrive to gain a better understanding of Life’s needs for water, nutrients, and energy. Astrobiology in the classroom Life Here and Out There Educator Guide. p. 11 <http://nai.arc.nasa.gov/library/downloads/ERG.pdf>

ADDITIONAL RESOURCES

Astrobiology Activity Guide pdf

<http://nai.arc.nasa.gov/library/downloads/ERG.pdf>

Articles from NASA’s Astrobiology Community

<http://astrobiology.nasa.gov/>

A NASA web where students may pose questions to astrobiologists

<http://astrobiology.nasa.gov/ask-an-astrobiologist/>

MATERIALS

Astrobiology Activity Guide

[Life on Earth ...And elsewhere](#)

What is Life?

- One Activity Guide (page 9) for each student
- Pairs of objects (see Step 1) for each group:
 - two hand lenses
 - three jars
 - hot tap water in a container
 - 150 mg sand
 - 15 mg sugar
 - half a packet of active dry yeast
 - one fizzing-style antacid tablet

What Does Life Need to Live?

- one Activity Guide (pages 16 and 17) for each student
- How to tell what’s growing in your environment (page 19) key for each group
- One to two sets of environment cards (page 15)
- Materials for the 12 environments (see page 14, Teacher notes on the twelve environments for growing organisms):
 1. Seeds: Quick growing seeds, damp paper towel or soil, and plastic baggie
 2. Pond Environment: open container with pond sediment and loose materials from a local pond, such as sticks and plants.
 3. Apple: ½ apple in an open bowl
 4. Grapes: slightly crushed grapes in water.
 5. Brine Shrimp: brine shrimp eggs available at pet stores and online. Container as described in the directions with the eggs.
 6. Yeast: 5 g of yeast (new package), 50 ml water, and 5 g sugar
 7. Bread: moist bread in a plastic baggie
 8. Dried beans: select dried beans, and 200 ml water
 9. Cheese: Cottage cheese, yogurt, or cream cheese
 10. Lettuce: Lettuce in plastic baggie
 11. Cornstarch & Rich Soil: 5 g cornstarch, 95 g soil, and water
 12. Hay: handful of hay and water
 13. *Student observations will be greatly improved if hand lenses and/or a microscope are available for use.

DISCUSSION QUESTION

What is Life?

- Which criteria were most important in helping you draw your conclusions? *Observing changes taking place within the containers and attempting to understand the source of the changes.*
- What conclusions did you draw about the rapid fizzing of Jar 3? *Adding water and sugar will result in no additional fizzing or reduced fizzing as the powder completes its reaction. The fix is a reaction between the antacid tablet material and the water; it is chemical and not living.*
- What kinds of follow-up tests might provide you pertinent information? *Sugar is a food source for energy, so living things should react to this substance. Student answers will vary according to the tests they propose.*
- Does no change mean that a sample contains nothing that is alive? *Possibly, or it is reacting in a way that is not visible to the unaided human eye.*

What Does Life Need to Live?

- What essential materials does the initial environment provide to organisms living in it? *Student answers will vary dependent upon the environment they are studying*
- Which of these essential materials may run out in less than 10 days? *Student answers will vary dependent upon the environment they are studying. This is particularly significant if the environment is an opened or closed container.*
- Predict what will be growing in your environment in 10 days. *Seedlings, microbes, or mold, depending upon the environment*
- How will you tell that the organisms inhabiting your environment are alive? *Student answers will vary dependent upon the environment they are studying. With the seedling, measurement of growth and color of the plant is visible and measureable, microbes would need to be observed under a microscope for signs of visible light processes.*

Additional student questions are included in the pdf guide.

ASSESSMENT ACTIVITIES

Student notebooks/journals will provide the observations and data required should the instructor wish to employ multimedia options for student presentations via podcasts or videos.

ENRICHMENT

Complete Design a Planet in AstroVenture

<http://astroventure.arc.nasa.gov/>